Specifications for supply of Spiral Casing castings

Component: Spiral Casing castings in two parts as Top half and Bottom half.

Material Composition: Material according to BHEL specification: HY 19569

(Specification enclosed).

Inputs supplied by BHEL: Following inputs shall be given for the manufacture of pattern and to cast the spiral casing.

1. Provisional Auto-cad drawing of a spiral casing (Drg. No.: 4-BP-334-45-02) with final machined dimensions is supplied for the purpose of submitting the offer. Final Auto-cad drawing for different casings (which are almost similar to the provisional drawing) shall be given at the time of ordering.

Scope of Work:

The scope of work and stages of inspection includes the following:

1. Vendor has to design the pattern to obtain accurate castings, without losing the geometrical accuracy intended.
2. Develop the pattern.
3. Produce the components.
4. Clean the castings, complete pre-machining and supply.

Quality plan

1. The design and drawings of pattern shall be submitted for verification.
2. The cross sectional area details of the pattern at different locations possible shall be checked.
3. After pre-machining, offer castings for visual and dimensional inspection at vender's works and issue certificate.
4. Material chemical composition test certificate of casting.
5. Mechanical properties of material of casting.
6. Carry out hydraulic pressure test which shall also be witnessed by BHEL. Top and bottom half assembled together shall be hydraulic pressure tested at 200 mwc for 30 minutes.
7. BHEL will inspect all the above at vendor's works prior to dispatch of casting.

Special Instructions:

1. The pattern/mould drawings shall be submitted to BHEL for the purpose of verification only.
2. Suitable allowances for casting, shrinkage and machining etc shall be added by the suppliers.

3. Development activity shall be carried out in close interaction with the HTF group, BHEL (R&D) with mutually agreed time schedule.
4. As the process of design is continuing, two independent designs with different spiral cross sectional areas are expected to emerge from the design. All other details remaining same, only the cross sectional hydraulic flow path shall be different. Vendor should submit offers for the scope of work specified, for the development of casings with both the designs.
5. It may be noted that out of the two independent designs with different spiral cross sectional areas expected and as it is developmental in nature, order may be placed for any one or for both the sets of castings.
6. After completion and supply of castings, the dies/patterns/moulds etc., developed shall be the sole property of BHEL.
7. Stages of inspection described above during the process of development shall be followed.

CARBON STEEL CASTINGS FOR GENERAL PURPOSE
GRADE : GP 240 GH

1.0 GENERAL:

This specification governs the quality requirements of carbon steel castings of grade GP 240-GH.

2.0 APPLICATION:

These castings are required for steam turbine, turbogenerator and pump components.

3.0 CONDITION OF DELIVERY :

The castings shall be supplied in normalised or quenched & tempered, rough machined, stress relieved and shot blasted condition. Cleaning of internal surface shall be ensured. The surface condition of the casting shall be suitable for magnetic particle and ultrasonic testing. The castings shall not be painted.

4.0 COMPLIANCE WITH NATIONAL STANDARDS :

This specification complies in general with DIN EN 10213-Part I&II-1995, Gr:GP240 GH.

5.0 DIMENSIONS AND TOLERANCES :

5.1 Dimensions: The enclosed drawings are finish machined ones (unless otherwise specified). The castings shall be supplied in rough machined condition with an allowance of 3 to 5 mm on the surfaces where machining symbols have been shown on the drawing. Small grooves, steps etc., need not be rough machined.

5.2 Tolerances: The tolerances shall be as per DIN:1683, GR:GTB-19.

6.0 MANUFACTURE:

The steel shall be manufactured by an electric melting process or by any other equivalent recognised practices.

7.0 HEAT TREATMENT :

The suggested heat treatment is given below:

7.1 **Normalising:** 900º C to 980º C followed by cooling in air.

7.2 **Hardening** : 890-980°C followed by oil quenching or air cooling.

7.3 **Tempering** : 600-700°C followed by air cooling.

7.4 **Stress relieving**: Min 580°C followed by furnace cooling.

The actual heat treatment cycle followed shall be reported in Test Certificate.

8.0 FINISH:

8.1 The Surface finish of the machined surfaces shall be as per ordering drawing.

8.2 The outer and inner surfaces of the castings shall be well cleaned and dressed in such a way that during magnetic particle testing, clear evaluation of defects is enabled. The surface quality must also enable the proper coupling of the probes in the portions where ultrasonic testing is to be performed.

8.3 If the surface quality is insufficient for the intended inspection, the surface must be ground. Surface cleaning by chiseling or caulking is not permitted. All fillets must also be ground approximately 70mm on each side of the centre line of fillet.

8.4 Minor surface defects are only to be ground off. Welding for appearance need not be carried out. The surface grinding should not impair the ultrasonic testability during testing in these portions.

9.0 FREEDOM FROM DEFECTS:

9.1 Foundry defects like blowholes, shrinkage cavities, porosity, non-metallic inclusions etc. appearing on the surfaces to be machined shall be opened out and smoothly ground provided the depth of any of these defects when so ground does not exceed 2/3 of the machining allowances.

9.2 In case where pressure tightness is called for (though the test may be required to be conducted at BHEL) the requisite quality shall be ensured to guarantee the same.

9.3 Where non-destructive tests are called for, the criteria for acceptance shall be governed by the requirements of these non-destructive tests and shall over rule clause 9.1 above.

9.4 All as cast surfaces shall be free from harmful foundry defects like slag inclusions, sand spots, cold shuts, shrinkage, scab etc.

9.5 Cracks are not permitted on any surface of the castings.

10.0 CHEMICAL COMPOSITION:

The melt analysis of the steel shall conform to the following requirements.

Element		C	Si	Mn	P	S	Cr	Mo	Ni	V	Cu
Melt ana-lysis	Min.	0.18	-	0.50	-	-	-	-	-	-	-
	Max.	0.23	0.60	1.20	0.030	0.020	0.30	0.12	0.40	0.03	0.30
Permissible variation in product analysis		±0.02	+0.10	-0.06 +0.10	+0.005	+0.005	-	-	-	-	-

Note : $Cr + Mo + Ni + V + Cu \leq 1.00$.

11.0 TEST SAMPLES:

11.1 When integral test piece is called for in the drawing / purchase order (for castings weighing less than 500 kgs), the test coupon shall be cast at a place of maximum section thickness or any position where casting quality is not affected. However, integral keel blocks shall necessarily be provided for castings weighing 500 kgs or more.

Otherwise separate test coupons shall be cast from the same melt from which the casting are poured.

11.2 The number of keel blocks to be integrally cast with each casting shall be sufficient to test the various properties, both at the suppliers end and at BHEL and to carry out repeat tests if required . Sufficent material in the form of integerally cast keel block or seperately cast test coupon duly identified and stamped by BHEL representative shall be sent to BHEL for retesting at BHEL works.

11.3 The integrally cast test coupons shall not be removed prior to complete heat treatment and they shall be suitably stamped and identified by BHEL representative.

11.4 Separate test coupons shall be heat treated along with the casting they represent and they shall be properly stamped and identified.

11.5 Testing shall be done per melt and per heat treatment batch in case of separate cast test coupons and individual casting shall tested where integral test pieces are called for.

12.0 MECHANICAL PROPERTIES:

The mechanical properties shall be as follows.

Tensile Strength N/mm^2	0.2% Proof stress, N/mm^2 min.	Elongation % L=5d min.	Charpy Impact Strength J Min.
420-600	240	22	27

Note: 1) The tensile tests shall conform as per IS:1608 or any National Standard.

2) The Impact test shall be conducted on specimen with dimensions 10x10x55mm with a 2mm ISO V-notch, as per IS:1757 or any other reputed national standard.

The minimum Impact value shown above is the average of three samples at the same location. Only one value can be the minimum value specified, but in no case less than 2/3rd of the same. All the three values shall be reported in the test certificate.

13.0 HYDRAULIC TEST:

The castings shall be subjected to hydraulic test at BHEL after finish machining, if mentioned in the drawing. The test pressure shall be two times the operating pressure and shall be maintained for a minimum of 30 minutes, unless otherwise specified, without leakage. In case the supplier is needed to carry out this test, the same shall be indicated in the drawing / purchase order

14.0 NON-DESTRUCTIVE TESTS:

The following non-destructive tests shall be conducted.

14.1 Magnetic Particle Test: Unless otherwise specified in the drawing / order, 100% area of the castings (technically feasible) shall be tested by magnetic particle examination. The acceptance norms shall be severity level 'S1' for weld ends and severity level 'S2' for rest of the casting surfaces as per DIN : 1690 part 2.

14.2 Ultrasonic Test: Unless other wise specified in the drawing/ order, 100% area of the casting (technically feasible) shall be tested ultrasonically. The acceptance level shall be severity level 'V1' for weld ends and severity level 'V2' for rest of the areas, as per DIN:1690 part 2.

15.0 REPAIR WELDING:

The defects in the castings shall be reported to BHEL by sending defectograms. Any repair by welding shall be done as per DIN EN 10213 only with the prior approval of BHEL.

16.0 INSPECTION AT SUPPLIER'S WORKS:

16.1 BHEL Inspector/BHEL authorized third party inspection agency will identify and mark the test pieces. Tests and inspection are to be conducted in presence of BHEL representative. Castings shall be despatched only after his approval.

16.2 The BHEL Inspector/BHEL authorized third party inspection agency shall have free access at all times while the work on the contract is being performed, to all parts of the manufacturer's works. The supplier shall offer him all reasonable facilities without charge to satisfy the latter that the material is being furnished in accordance with this specification.

17.0 TEST CERTIFICATE:

17.1 The supplier shall furnish five copies of test certificates (in English) to BHEL including one transparent copy. Each copy shall contain the following.

a) HY19569/Rev .04
b) BHEL Order No.
c) Item description and drawing no. of the casting
d) Supplier's name
e) Melt No. and Heat treatment cycle no.
f) Casting serial no. per melt
g) Details of manufacture
h) Heat treatment & welding details
i) Results of all tests as per this specification
j) Defectogram of weld repairs, if any.

17.2 The certificates shall be duly attested by chief of Inspection/ Chief Metallurgist of the supplier and BHEL representative.

18.0 MARKING :

The following details shall be punched clearly on casting and the same shall be encircled by paint.

a) HY 19569/Rev.04
b) Heat treatment batch no.
c) Melt No. & Serial No. of the casting
d) Drawing No.
e) Inspector's Stamp
f) Supplier's name

19.0 PRESERVATION & TRANSPORTATION:

The castings shall be properly protected from damage and corrosion during transport. The entire surface of the castings shall be applied with suitable non-greasy anticorrosive coating. Painting is not permitted on any surface.

20.0 REJECTION AND REPLACEMENT:

The final decision regarding acceptance or rejection rests with BHEL, if the casting is not found as per specification at any time during further operation on the casting.

The supplier shall replace the rejected casting at his own cost and the rejected casting shall be returned after all commercial terms and conditions are satisfied.